

STEM By The Book

Spy School Stuart Gibbs

Experiences and Outcomes

Through creative play, I explore different materials and can share my reasoning for selecting materials for different purposes. **SCN 0-15a**

Through exploring properties and sources of materials, I can choose appropriate materials to solve practical challenges. **SCN 1-15a**

By contributing to investigations into familiar changes in substances to produce other substances, I can describe how their characteristics have changed. **SCN 2-15a**

I have collaborated in activities which safely demonstrate simple chemical reactions using everyday chemicals. I can show an appreciation of a chemical reaction as being a change in which different materials are made. **SCN 2-19a**

I can recognise a variety of materials and suggest an appropriate material for a specific use. **TCH 1-10a**

I can recognise basic properties and uses for a variety of materials and can discuss which ones are most suitable for a given task. **TCH 2-10a**

Resources

- Whole red cabbage
- Paintbrush
- Cotton buds
- Twigs
- White paper
- Measuring jug
- Sieve/strainer
- Lemon juice
- Lime juice
- Vinegar
- Milk
- Transparent hand wash
- Bicarbonate of soda



Activity – Red Cabbage Reveal

Ben is recruited to Spy School because of his amazing cryptography skills. Cryptography is a way of sending messages securely so that only someone with the key can read them.

Let's look at another type of secret message you might learn about at Spy School.

First of all you will need to prepare the messages you want the other person to be able to read.

To do this you will need to use a fine paint brush, cotton bud or twig dipped in your choice of "invisible ink". We suggest trying lemon or lime juice, clear vinegar, milk, bicarbonate of soda mixed with water (one teaspoon of bicarbonate of soda to 20ml water) or transparent liquid soap. It is important to make sure any household chemicals you use are safe, avoid using bleach, washing powder or gels and oven cleaners.

Write a message of your choice on white paper using your ink (Figure 1) and allow it to dry, once dry the message should become very hard to see.

Now it's time to prepare your red cabbage so the message can be revealed, an adult may be required as this involves hot water and using a knife.

Finely chop about a quarter of the red cabbage and place it in a measuring jug before pouring hot water over the top and leaving it to cool. (Figure 2)

Once the water has cooled it should be a deep purple colour, now strain the liquid into another jug. This is your red cabbage indicator.

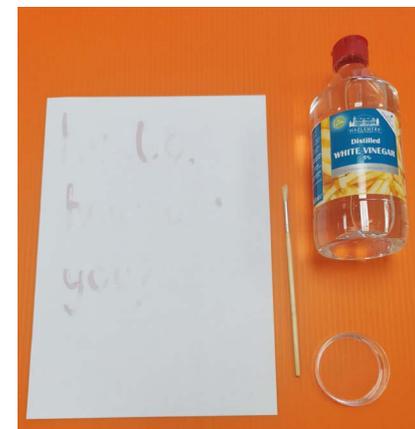


Figure 1



Figure 2

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It's now time to reveal your secret message, dip a wide paintbrush in the red cabbage indicator and brush it over the previously prepared message and all will be revealed, (Figure 3)

Try the reveal on messages made with different inks, you should see the messages revealed in a variety of colours.

Once finished dispose of the red cabbage indicator or freeze it for use at another time, if left out it will begin to produce an unpleasant smell.

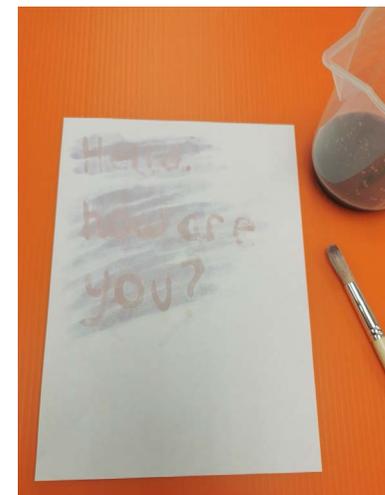


Figure3

What is happening?

Red cabbage is a natural indicator which changes colour when it comes into contact with chemicals of differing pH such as the ink used to write the message.

The colour of the message revealed will depend on the pH of the liquid used to write the message. Learners should be able to identify if the ink used was acidic or alkaline.

Below is a red cabbage colour indicator chart which shows the expected colour change when the indicator comes into contact with differing pH levels.

Red Cabbage Color Indicator Chart

pH	pH less than 7 = Acid			pH more than 7 = Base		
	2	4	6	8	10	12
Color	Red	Purple	Violet	Blue	Blue-Green	Green-Yellow

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What next?

For more information and instructions on how to carry out this activity, you can watch a video of [Red cabbage Reveal](#)

You can discover many more ways of making secret messages in our [Early Years and Primary Bulletin – No 91](#)

You may want to discuss examples of cryptography throughout history, for examples Bletchley Park was home to codebreakers during WW2 who helped decode enemy messages. [The Bletchley Park website](#) offers virtual lessons and access to resources for you to explore, including a template to make your own Cipher Wheel.

